REVIEW DRAFT

Landsat 7 Image Assessment System (IAS) Release Implementation Plan

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Landsat 7
Image Assessment System (IAS)
Release Implementation Plan

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Abstract

This document contains the software release implementation plan that defines the incremental buildup of functionality for the Landsat 7 Image Assessment System (IAS). The allocation of software to releases is based on an analysis of the requirements contained in the IAS Element Specification, related Interface Control Documents (ICDs), and the Landsat 7 Ground System Integration and Test Plan and the IAS design presented in the IAS System Design Specification and IAS Critical Design Specification documents. The availability of candidate software for reuse, including software from previous Landsat missions and prototypes of Landsat-7 radiometry and geometry algorithm software, and the sizing of new software were considered in allocating software to releases.

Keywords:

Landsat 7
Landsat 7 Image Assessment System (IAS)
EDC Distributed Active Archive Center (EDC DAAC)

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SECTION 1 -- INTRODUCTION

1.1 Purpose

The IAS Release Implementation Plan documents the system release approach that will be used in implementing the Landsat 7 Image Assessment System (IAS).

A system release approach is an incremental approach to implementing, integrating, and testing systems. A system release is a portion of a system that satisfies an identifiable subset of the total system requirements. As the system is developed, each successive release adds to the system functionality provided in previous Releases.

This plan describes the individual releases that will be developed in implementing the IAS. It provides a detailed definition of the requirements and functions allocated to each release and maps software tasks and modules to each release. It also presents the release implementation schedule that must be followed to support the Landsat 7 Ground System test schedules.

1.2 Reference Documents

The following documents contain background and/or detailed information which was referenced in creating the IAS Release Implementation Plan.

1. NASA GSFC/MO&DSD, Landsat 7 Image Assessment System (IAS) Element Specification, 430-15-01-001, October 1996

2. Computer Sciences Corporation, Landsat-7 Mission Operations Center (MOC) to Image Assessment System (IAS) Interface Control Document (ICD), November, 1995.

3. NASA/GSFC, 514-1ICD/0195, Interface Control Document (ICD) Between the Image Assessment System (IAS) and the Landsat-7 Processing System (LPS), January 31, 1996.

4. Hughes Information Technology Systems, 209-CD-013-003, Interface Control Document Between EOSDIS Core System (ECS) and the Landsat 7 System, March 1996.

5. NASA GSFC/MO&DSD, Landsat 7 Image Assessment System (IAS) System Design Specification, February 1997

6. NASA GSFC/MO&DSD, Landsat 7 Image Assessment System (IAS) Critical Design Specification, March 1997

7. NASA GSFC/MO&DSD, Landsat 7 Image Assessment System (IAS) Interface Definition Document (IDD), December 1996

8. NASA GSFC/MO&DSD, Landsat 7 Image Assessment System (IAS) System Integration and Test Plan, March 1997

9. NASA GSFC/MO&DSD, Landsat 7 Ground System Integration and Test Plan, 510-2ITP/0395, January 1997

SECTION 2 --- SYSTEM OVERVIEW

2.1 IAS Objectives

The Image Assessment System (IAS) is an element of the Landsat-7 Ground Data Handling Segment. The primary objectives of the IAS are to:

- assess the quality of a small sample of the Level 0R data archived by the EROS Data Center (EDC) Distributed Active Archive Center (DAAC);
- calibrate the on-orbit radiometry and geometry of the Landsat-7 Enhanced Thematic Mapper + (ETM+) instrument and satellite; and
- provide the resulting correction and registration parameters to the DAAC for generation of Level 1 products, for distribution to users ordering Level 0R ETM+ data, or in response to user requests for the parameters.

To meet these objectives, the IAS must perform the following functions:

- radiometrically correct and geometrically register Level 0R ETM+ data to create Level 1 digital image data;
- perform radiometric calibration;
- perform geometric calibration;
- evaluate data quality; and
- report results to the DAAC, Landsat-7 Processing System (LPS), and the Landsat-7 Mission Operations Center (MOC).

2.2 IAS Subsystem Description

The IAS capabilities are partitioned into six subsystems The following paragraphs describe the purpose and basic functionality of each subsystem. A more detailed description of each subsystem can be found in the IAS System Design Specification and the IAS Critical Design Specification.

User Interface

Two distinct user interfaces are provided for IAS - one for the IAS Operator position and a second for the IAS Analyst position. The Operator user interface is provided through Oracle Forms. The Analyst user interface is

provided through the Interactive Data Language (IDL). Both interfaces allow the user to select operations to be performed.

Process Control Subsystem (PCS)

The Process Control Subsystem provides the tools needed by the IAS Operator to plan and manage the processing being performed by the IAS. PCS applications are used by the Operator to browse EDC DAAC holdings and order data for ingest, or to make calibration scheduling requests to the Mission Operations Center. PCS provides the Operator with the capability to establish Work Orders specifying the processing to be performed on the data ingested by the IAS and to set priorities for Work Order execution.

PCS also controls the execution of Radiometric and Geometric Processing Subsystem applications by initiating and managing Work Order processing.

Data Management Subsystem (DMS)

The Data Management Subsystem manages the data formatting and transfer interfaces with external systems. It performs ftp functions during data ingest, stores the data in the appropriate internal data stores, and updates data availability information. For data export, DMS performs the appropriate data formatting and supports the ftp transmission of these data to external systems.

DMS also performs quality checking and correction of the Level 0R Products. This function is performed once upon receipt of the product from the EDC DAAC. During Work Order startup, DMS also performs a data preparation function, extracting the requested subset of data from the Payload Correction Data (PCD), and possibly the Mirror Scan Correction Data (MSCD) and image files.

Evaluation and Analysis Subsystem (E&A)

The E&A Subsystem supports the IAS Analyst in evaluating and analyzing the performance of the ETM+ instrument and in maintaining the Calibration Parameter File. To accomplish this, E&A provides: a GUI to other applications; utilities to view radiometric and geometric processing inputs, intermediate products, and results; “generic” image processing applications for image analysis and statistical analysis; and file edit and Work Order Setup applications for performing “what if” analyses.

Radiometric Processing Subsystem (RPS)

The Radiometric Processing Subsystem provides all functionality required for Level 1R product generation, radiometric calibration, and radiometric characterization and evaluation. This subsystem implements all of the IAS radiometry algorithms.

Geometric Processing Subsystem (GPS)

The Geometric Processing Subsystem provides all functionality required for Level 1G product generation, geometric calibration, and geometric characterization and evaluation. This subsystem implements all of the IAS geometry algorithms.

2.3 IAS Implementation Responsibilities

The IAS "infrastructure" subsystems - Process Control Subsystem, Data Management Subsystem, and Evaluation & Analysis - are being developed by the Computer Sciences Corporation (CSC) through the Consolidated Network Management and Operations Support (CNMOS) Contract in support of NASA/GSFC Code 514. The Radiometric Processing Subsystem is being developed by the Algorithm Implementation Team (AIT), an integrated product team of personnel from GSFC, CSC, Century Computing, and SGT, Inc. The Geometric Processing Subsystem is being developed by the IAS Project at the EROS Data Center in Sioux Falls, SD.

SECTION 3 --- RELEASE PLAN

3.1 IAS Release Capability Summary

The IAS will be implemented in two releases. Release 1 will support early Landsat 7 Ground System integration and test activities. It will implement external interfaces to the EDC DAAC and the Mission Operations Center (MOC) as well as core Level 1 processing functionality. Release 2 will implement the remaining IAS system requirements, incorporating all of the calibration and evaluation and analysis functions. The functions that will be developed in each Release are summarized in Table 3-1. IAS system requirements are mapped to Releases in Appendix A, software sizing estimates for each Release are provided in Appendix B, and a mapping of IAS tasks and modules to Releases is presented in Appendix C.

Release 1 will provide the capabilities required to generate a precision-corrected Level 1 image dataset (1Gp). IAS "infrastructure" capabilities implemented in Release 1 will include functions for generating requests for data acquisition to the MOC, ordering and ingesting Level 0R products from the EDC DAAC, defining and controlling the processing of Work Orders, and the basic Operator and Analyst user interfaces. In addition, capabilities allocated to the Interactive Data Language (IDL) and Environment for Visualizing Imagery (ENVI) Commercial Off-the-Shelf (COTS) products within the Evaluation and Analysis (E&A) subsystem will be provided to support Level 0R and Level 1 dataset display and analysis. RPS functions implemented in Release 1 will be used to characterize the Level 0R data and generate Level 1R datasets, while GPS Release 1 functions will generate systematic (1Gs) and precision-corrected (1Gp) datasets.

Release 2 will complete the functionality of the IAS. The IAS infrastructure will be expanded to include the full complement of process control, data management, and user interface capabilities, as well as custom evaluation and analysis tools.

The RPS will be expanded to implement the remaining radiometric characterization algorithms and all of the radiometric calibration algorithms. The GPS will be expanded to implement the remaining geometric characterization and calibration algorithms. With these capabilities in place, all of the parameters in the Calibration Parameter File can be maintained, all of the required analyses can be performed, and all of the required performance reports can be generated.

It is likely that a post-launch release will be necessary to accommodate changes required in algorithms, especially those related to FASC and PASC processing and in the interface with the EOSDIS Core System (ECS).

Table 3-1. Allocation of IAS Functions to Releases (1 of 2)

SUBSYSTEM	RELEASE 1	RELEASE 2
User Interface	Operator Interface	
	Analyst Interface	
Data Management	Ingest Level 0R Products from the EDC DAAC	
	Quality Assess Level 0R Products	Correct MSCD and PCD
	Associate Level 0R Product with Work Order	
	Format Files for Transmission to External Systems	Generate Calibration Parameter File
	Ingest Data from MOC	
	Convert Ephemeris	
	Manage Work Order Directories	Manage Disk Space
Process Control	Start Up IAS	
	Schedule Work Order	
	Process Work Order	
Evaluation & Analysis	Display Level 0R Product files (imagery and ancillary data)	
	Display algorithm results - flat files	
	Display algorithm results - database queries	
		Create reports

Table 3-1. Allocation of IAS Functions to Releases (2 of 2)

SUBSYSTEM	RELEASE 1	RELEASE 2
Radiometric Processing Subsystem	Characterize Level 0R image (Dropped Lines, Impulse Noise, Detector Saturation, Histogram Analysis)	Characterize Level 0R image (Memory Effect, Coherent Noise, Random Noise, Scan-Correlated Shift)
		Correct Level 0R image (Memory Effect, Coherent Noise, Scan-Correlated Shift)
	Process IC Reflective Data (Generate IC gains and biases)	Process IC Emissive Data (Generate IC gains and biases) Process FASC and PASC data (Generate FASC and PASC gains and biases)
		Generate Combined Radiometric Model (CRaM)
	Generate Level 1R image (Apply Radiometric Correction)	
	Characterize Level 1R image (MTF, Banding and Striping)	
	Correct Level 1R image (Dropped Lines, Dead Detectors, Saturated Detectors, Banding, Striping)	
Geometric Processing Subsystem	Generate 1Gs and 1Gp Image (Create Model, Generate Grid, Call Model, and Resample)	Perform Terrain Correction
		Perform Geometric Calibration (Sensor Alignment, Scan Mirror, Band Placement)
		Perform Geometric Characterization (Geometric Accuracy, Geodetic Accuracy, Image-to-Image Registration, Band-to-Band Registration)

3.2 IAS Release Schedule

Table 3-2 presents the IAS schedule from the beginning of Release 1 implementation through IAS site installation at EDC.

Table 3-2: IAS Implementation Schedule

Planned Start	Planned Finish	Description
3/18/97	09/12/97	Release 1 Implementation (IAS & RPS)
	7/1/97	EDC GPS Release 1 Delivery
6/16/97	8/1/97	Release 1 System Integration
8/4/97	9/12/97	Release 1 System Test
	09/12/97	Release 1 Completed
06/16/97	01/16/98	Release 2 Implementation (IAS & RPS)
	09/12/97	EDC GPS Release 2 Delivery
11/5/97	12/1/97	Release 2 System Integration
12/2/97	01/16/98	Release 2 System/Factory Acceptance Test
	01/16/98	Release 2 Completed
1/20/98	2/6/98	EDC Site Installation
2/6/98	TBD	EDC Site Acceptance Test

Note that Release 2 system testing and factory acceptance testing occur simultaneously.

3.3 Required Resources

This section describes the system hardware, test resources, and allocation of major Commercial Off-the-Shelf (COTS) software for the IAS implementation.

3.3.1 IAS System Hardware

Figure 3-1 shows the IAS development environment, including elements resident at GSFC, the Consolidated Network Management and Operations Support (CNMOS) contract's Greentec IV facility, and the EDC.

TBS

Figure 3-1. Development Environment

iasdev1 and iasdev2 are SGI Challenge L servers that will be dedicated for software development throughout the entire development process. iasdev1 will be located at the CSC Greentec IV facility and iasdev2 will be located at GSFC Building 23.

ias001 and ias002, SGI Origin 2000s with 4 processor 32 GB memory configurations, are the target computers for the IAS operational system. These computers, which will be located at GSFC Building 23, will be allocated for Release 1 software development and for system test throughout the development and system testing process.

IAS Analyst Workstations (iaswork1, iaswork2, and iaswork3) are SGI O2 workstations that will be used operationally for image evaluation and analysis. Two of these workstations will be located at the CSC Greentec IV facility and the third will be located at GSFC Building 23. These systems will be available for software development through the entire development process. One or two of these systems will be allocated for system test following the delivery of Release 1 from the Development Team to the System Test Team.

The EDC Landsat 7 Development System (edcdev), an SGI Origin 200, will be available for software development through the entire development process.

The EDC Landsat 7 Integration and Test System (edci&t), an SGI Origin 2000, may be used by EDC following the completion of Release 1 System testing at GSFC to receive and "Release" the Release 1 IAS. This activity will be used by EDC to validate software delivery procedures planned for use with Release 2 and to gain experience in building the IAS from source code.

The IAS hardware will be accessible to the implementation and test teams 24 hours a day, 7 days a week. Access on evenings and weekends will be provided via a small number of keys. Development terminals, printers and network connections will be available to the IAS team members at the CNMOS Greentec IV facility and at GSFC.

3.3.2 Commercial Off-the-Shelf Software

Several COTS products will be procured to support software development or to provide IAS system functionality. Table 3-3 identifies the COTS products to be procured and allocates COTS licenses across the IAS computers. The Table includes only COTS products procured by GSFC or CSC; it does not include COTS products procured by EDC or H/STX.

TABLE 3-3 --- TBS

Table 3-3: COTS License Allocation

Product	Vendor	Total Copies	IPD Case	ias dev 1	ias dev 2	ias 001	ias 002	ias work1	ias work2	ias work3
Analysis/Design										
RTM										
Teamwork										
Designer 2000										
S/W Development										
Pro*C Dev/ KDebugger										
IDL										
SQLPlus										
Purify										
CM Tools										
RPS										
PVCS										
Other Applications										
ENVI										
Framemaker										
Netscape										
Statistics Package										

3.3.3 Test Tools and Data

Simulated Landsat 7 Level 0R Distribution Products will be required to support both Release 1 and 2 testing. This data must be available early in Release 1 to support unit, module, integration and system test.

IAS plans to use the Generic Telemetry SIMulator (GTSIM) to ingest Landsat 5 datasets and generate Landsat 7 data streams for specific scenes of interest, including scenes containing specific image artifacts. These data will then be processed through the Landsat Processing System (LPS) and an IAS-developed data formatter to generate Level 0R Products in the required HDF format. Additional Landsat 7 data will be available from spacecraft and instrument tests.

Data editors may need to be developed to assure the availability of the remaining Level 0R product files with the required data fields. These files include metadata, PCD, MSCD, and geolocation tables. Wherever possible, tools from LPS and standard Hierarchical Data Format (HDF) utilities will be used to generate or edit these files.

External system simulators may need to be developed in order to eliminate schedule dependency on external Landsat 7 ground system elements. The availability of EOSDIS DAAC elements is of special concern.

Test tools and data are addressed in more detail in the Landsat 7 Image Assessment System (IAS) Integration and Test Plan.

Appendix A — Mapping of IAS Element Requirements to Releases

The following table maps the requirements specified in the IAS Element Specification to the Releases in which the requirements are satisfied (i.e. fully testable). Some requirements are not allocated to software and, therefore, are not mapped to software requirements.

Reqt Number	Requirement Statement	R1	R2
3.2.1.1.1	The IAS shall interface with the EDC DAAC for purposes of searching for and ordering of data from the Landsat 7 archive.	X	
3.2.1.1.2	The IAS shall receive Level 0R data, Level 0R products, and associated ancillary data from the EDC DAAC.	X	
3.2.1.1.3	The IAS shall interface with the EDC DAAC to coordinate the transfer of calibration parameter files and IAS-generated reports.	X	
3.2.1.1.4	The IAS shall send calibration parameter files and IAS-generated reports to the EDC DAAC.	X	
3.2.1.2.1	The IAS shall interface with the LPS to coordinate the transfer of calibration parameter files and reprocessing requests.		Ops
3.2.1.2.2	The IAS shall send reprocessing requests to the LPS.		Ops
3.2.1.2.3	The IAS shall receive disposition of reprocessing requests from the LPS.		Ops
3.2.1.2.4	The IAS shall send calibration parameter files to the LPS.	X	
3.2.1.3.1	The IAS shall send requests to the MOC for the operational acquisition of partial-aperture calibration data, full-aperture calibration data, and surface image data of radiometric and geometric calibration ground sites.	X	
3.2.1.3.2	The IAS shall coordinate with the MOC for the acquisition of ETM+ imagery required for calibration and image assessment, for the transfer of calibration parameter files, and for the transfer of problem reports.		Ops
3.2.1.3.3	The IAS shall send requests to the MOC for concentrated definitive ephemeris.	X	
3.2.1.3.4	The IAS shall send problem reports to the MOC.	X	
3.2.1.3.5	The IAS shall send calibration parameter files to the MOC.	X	
3.2.1.3.6	The IAS shall be capable of receiving telemetry trend reports, spacecraft status reports, and event schedules from the MOC.	X	
3.2.1.3.7	The IAS shall be capable of receiving Flight Dynamics Facility (FDF)-generated, definitive ephemeris from the MOC.	X	
3.2.1.4.1	The IAS shall send problem reports and summary reports to the MMO.	X	
3.2.2.1.1	The IAS shall be able to use data from the internal calibrator in the calibration of the radiometric response of each ETM+ detector.		X
3.2.2.1.2	The IAS shall be able to calibrate the radiometric response of each ETM+ detector, except band 6, using data from the partial-aperture solar calibrator (PASC).		X
3.2.2.1.3	The IAS shall be able to calibrate the radiometric response of each ETM+ detector, except band 6, using data from the full-aperture solar calibrator (FASC).		X
3.2.2.1.4	The IAS shall be able to calibrate the radiometric response of each ETM+ detector given Level 0R data of a ground calibration site and corresponding at-aperture spectral radiance values.		

Reqt Nmber	Reqirement Statement	R1	R2
3.2.2.1.5	The IAS shall be able to calibrate the radiometric response of each ETM+ detector sing Level 0R data from preship and prelanch calibration sorces and axiliary calibration sorce data.	X	
3.2.2.1.6	The IAS shall have the capability of assessing the short-term and long-term stability of the onboard calibration sorces, which inclde the FASC, the PASC, and the internal calibrators.		X
3.2.2.1.7	The IAS shall be able to integrate the reslts of the varios calibration processes into an optimal estimate of radiometric calibration of each detector (except band 6) and provide new calibration parameters.		X
3.2.2.1.8	The IAS shall be capable of generating radiometric calibration pdates for the calibration parameter file.		X
3.2.2.1.9	The IAS shall be able to transfer the calibration of each detector to the internal calibrator.		X
3.2.2.2.1	The IAS shall be capable of determining the misalignment between the satellite navigational base reference and the ETM+ payload line-of-sight (LOS).		X
3.2.2.2.2	The IAS shall be capable of determining band-to-band registration parameters.		X
3.2.2.2.3	The IAS shall be capable of characterizing and pdating along and across scan parameters (i.e., scan mirror profiles, scan-line corrector mirror profile, detector offsets, detector delays).		X
3.2.2.2.4	The IAS shall be capable of generating geometric calibration pdates for the calibration parameter file.		X
3.2.2.3.1	The IAS shall be capable of processing payload correction data (PCD) data to correct spacecraft time, generate a sensor pointing model (attitde and jitter), and calclate spacecraft position and velocity (ephemeris).	X	
3.2.2.3.2	The IAS shall be capable of processing ETM+ Level 0R prodcts to prodce radiometrically corrected Level 1R image data.	X	
3.2.2.3.3	The IAS shall be capable of creating systematically corrected ETM+ Level 1G imagery from Level 0R prodcts.	X	
3.2.2.3.4	The IAS shall be capable of creating precision corrected ETM+ Level 1G imagery from Level 0R prodcts and grond control points (GCPs).	X	
3.2.2.3.5	The IAS shall be capable of creating terrain corrected ETM+ Level 1G imagery from Level 0R prodcts, GCPs, and elevation data.		X
3.2.2.3.6	The IAS shall be capable of performing image-to-image registration.		X
3.2.2.3.7	The IAS shall be capable of incorporating IAS-generated calibration coefficient pdates to generate Level 1 data.	X	
3.2.2.3.8	The IAS shall spport nearest neighbor, cbic convoltion, and modlation transfer fnction (MTF) compensation resampling.	X	
3.2.2.3.9	The IAS shall have the capability to prodce a 1G prodct with a grid cell size that is variable from 15 to 60 meters, in increments of 1 millimeter (mm).	X	
3.2.2.3.10	The IAS shall have the capability to map project 1G sing the Space Obliqe Mercator, niversal Transverse Mercator, Lambert Conformal Conic, Transverse Mercator, Obliqe Mercator, and Polyconic coordinate reference systems.	X	

Reqt Nmber	Reqirement Statement	R1	R2
3.2.2.3.11	The IAS shall have the capability to create a 1G image oriented to nominal path or north-p.	X	
3.2.2.3.12	The IAS shall be capable of processing Mirror Scan Correction Data (MSCD) to generate scan mirror and scan line corrector mirror models.	X	
3.2.2.3.13	The IAS shall be capable of compensating for inoperable and satrated detectors dring Level 1R and 1G processing.	X	
3.2.2.3.14	The IAS shall be capable of compensating for the image artifacts of striping, banding, coherent noise, memory effect, and scan correlated shift in Level 1R and 1G processing.		X
3.2.2.3.15	The IAS shall be capable of processing to Level 1R and 1G both ascending and descending pass ETM+ Level 0R data.	X	
3.2.2.4.1	The IAS shall evalate the on-orbit operability of ETM+ detectors.		X
3.2.2.4.2	The IAS shall be able to evalate the absolte radiometric accracy of ETM+ Level 0R, 1R, and 1G data.		X
3.2.2.4.3	The IAS shall be able to assess the identified ETM+ radiometric image artifacts of striping; banding; random, correlated, and coherent noise; memory effect; and scan-correlated shift.		X
3.2.2.4.4	The IAS shall be able to evalate the MTF of each ETM+ detector.	X	
3.2.2.4.5	The IAS shall be able to evalate the signal-to-noise ratio (SNR) of each ETM+ detector, sing prelanch and on-orbit image data.		X
3.2.2.4.6	The IAS shall be capable of evalating the on-orbit radiometric response of each ETM+ detector with respect to dynamic range.		X
3.2.2.4.7	The IAS shall be capable of evalating the on-orbit radiometric response of each ETM+ detector, exclding band 6, with respect to linearity (TBD).		X
3.2.2.4.8	The IAS shall be able to evalate the geodetic accracy of ETM+ Level 1G image data.		X
3.2.2.4.9	The IAS shall be able to evalate the internal geometric accracy of ETM+ Level 1G image data.		X
3.2.2.4.10	The IAS shall be able to evalate the band-to-band registration accracy of ETM+ imagery.		X
3.2.2.4.11	The IAS shall be able to evalate the image-to-image registration accracy of ETM+ data.		X
3.2.2.4.12	The IAS shall be able to evalate the qality of Level 0R prodcts. Qality checks will inclde bt not be limited to those listed in Table 3.2.2.4-1.	X	
3.2.2.4.12a	The IAS shall provide the capability to visally check L0R Prodct imagery.	X	
3.2.2.4.12b	The IAS shall range check all bt the hosekeeping parameters in the L0R Prodct Payload Correction Data.	X	
3.2.2.4.12c	The IAS shall validate scan direction consistency in the L0R Prodct Mirror Scan Correction Data.	X	
3.2.2.4.12d	The IAS shall validate FHSERR/SHSERR consistency in the L0R Prodct Mirror Scan Correction Data.	X	
3.2.2.4.12e	The IAS shall validate conted line length consistency in the L0R Prodct Mirror Scan Correction Data.	X	
3.2.2.4.12f	The IAS shall validate dropped line locations in the L0R Prodct Mirror Scan Correction Data.	X	

Reqt Nmber	Reqirement Statement	R1	R2
3.2.2.4.12g	The IAS shall validate the consistency of the applicability date in the Calibration Parameter File with the L0R Prodct image files.	X	
3.2.2.4.12h	The IAS shall validate the consistency of the Calibration Parameter File of the L0R Prodct with the IAS database.	X	
3.2.2.4.12I	The IAS shall spport validation of ACCA scores from the L0R Prodct metadata throgh visal inspection of the associated L0R image files.	X	
3.2.2.4.12j	The IAS shall validate scene coordinates from the L0R Prodct metadata.	X	
3.2.2.4.12k	The IAS shall validate file name consistency from the L0R Prodct metadata.	X	
3.2.2.4.12l	The IAS shall validate the correctness of WRS scene parameters from the L0R Prodct metadata.	X	
3.2.2.4.12m	The IAS shall validate calibration otliers in the L0R Prodct Calibration Plse/Shtter data.		X
3.2.2.4.12n	The IAS shall validate shtter means in the L0R Prodct Calibration Plse/Shtter data.		X
3.2.2.4.12o	The IAS shall validate shtter standard deviations in the L0R Prodct Calibration Plse/Shtter data.		X
3.2.2.4.12p	The IAS shall validate shtter otliers in the L0R Prodct Calibration Plse/Shtter data.		X
3.2.2.4.13	The IAS shall be capable of performing a trend analysis over any desired time interval for each selected evalation activity.		X
3.2.2.4.15	The IAS shall provide the capability to visally inspect image data.	X	
3.2.2.4.16	The IAS shall provide a capability that allows an image analyst to monitor assessment processes and reslts.	X	
3.2.2.4.17	The IAS shall have the capability to review otpt data, inclding bt not limited to calibration reports and pdates.	X	
3.2.2.5.1	The IAS shall have the capability to acqire, develop, test, and add new algorithms and software to improve the radiometric and geometric properties of ETM+ data and their assessment withot impacting IAS operations.		X
3.2.2.5.2	The IAS shall spport the development of algorithms to remove image artifacts and detector otages from Level 1R and 1G data withot impacting normal IAS operations.		X
3.2.2.5.3	The IAS shall have the capability to incorporate new algorithms into the operational system withot impacting normal IAS operations.		X
3.2.2.5.4	The IAS shall maintain configration control of all algorithms, databases, software, and hardware sed in operations.	X	
3.2.2.6.1	The IAS shall provide the capability to select the processing to be applied to data sets.	X	
3.2.2.6.2	The IAS shall be capable of archiving all software and databases sed in operations.		X
3.2.2.6.3	The IAS shall be capable of storing selected data, parameters, ancillary data, reports, and docments.	X	
3.2.2.6.4	The IAS shall have the ability to monitor and control processes.	X	
3.2.2.6.5	The IAS shall be capable of storing selected GCPs and GCP chips.	X	
3.2.2.6.6	The IAS shall be capable of storing selected digital elevation models (DEMs).		X

Reqt Nmber	Reqirement Statement	R1	R2
3.2.2.6.7	Deleted.		
3.2.2.6.8	The IAS shall be capable of storing solar spectral and broadband radiance data.	X	
3.2.2.6.9	The IAS shall have the capability to write otpts to tape.	X	
3.2.2.6.10	The IAS shall have the capability to generate hardcopy otpts.	X	
3.2.2.6.11	The IAS shall archive selected prelanch data, inclding bt not limited to sensor engineering, ETM+ image data, alignment matrices, calibration measrements, mirror scan profiles, FASC bi-directional reflectance distribtion fnction (BRDF), etc.		X
3.2.2.6.12	The IAS shall allow the operator to select thresholds for reslts and errors reported by the IAS.	X	
3.2.2.6.13	The IAS shall atomatically generate messages and alarms to alert the operator to IAS reslts and errors that exceed selected thresholds.	X	
3.2.2.7.1	The IAS shall generate calibration, data qality assessment, and problem reports.		X
3.2.2.7.2	The IAS shall be capable of generating metadata for all reports sent to the EDC DAAC Gide Server.		X
3.2.2.7.3	The IAS shall generate annal reports that docment calibration coefficient and performance analysis trends.		X
3.2.2.7.4	The IAS shall generate reports of anomaly detection analyses as they are conclded.		X
3.2.2.7.5	The IAS shall generate processing smmaries after each IAS activity.		X
3.2.3.1	The IAS shall be capable of calibrating the radiometric response (absolte spectral radiance) of each operable ETM+ detector to an accracy of 5 percent, 1 sigma, providing all inpts are within specification.		X
3.2.3.2	The IAS shall be capable of calibrating the relative radiometric response sch that the ratio of ETM+ eqivalent at-apertre radiances between any combination of two spectral bands, exclding band 6, shall vary less than 2 percent, 1 sigma, over a 7-day p		X
3.2.3.3	The IAS shall contribte no greater than 0.7 percent ncertainty to absolte radiometric accracy dring the generation of Level 1R and 1G data.		X
3.2.3.4	The IAS shall be able to create systematic imagery to a geodetic accracy of 250 meters, 1 sigma, providing all inpts are within specification. Performance applies to along-track and cross-track directions and is referenced to a nadir-viewing geometry.		X
3.2.3.5	The IAS shall contribte circlar errors no greater than 1.8 meters, 1 sigma, in the prodction of systematically corrected ETM+ Level 1G imagery. This error is referenced to a nadir-viewing geometry and excldes the effect of terrain correction.		X
3.2.3.6	The IAS shall provide the capability to register pixels from a band to the corresponding pixels of the other bands in a common scene to an accracy of 0.28 sensor gide star data (GSD), 0.9p, in along-track and cross-track directions, providing all inpts		X
3.2.3.7	The IAS shall contribte error no greater than 0.11 mltispectral sensor GSD, 0.9p, along-track, and 0.24 mltispectral sensor GSD, 0.9p, cross-track, in the assessment of band-to-band registration.		X

Reqt Nmber	Reqirement Statement	R1	R2
3.2.3.8	The IAS shall provide the capability to perform image-to-image registration to an accracy of 0.4 mltispectral sensor GSD, 0.9p, in the along-track and cross-track directions providing all inpts are within specification.		X
3.2.3.9	The IAS shall contribte circlar errors no greater than 3.6 meters, 1 sigma, dring image-to-image registration correction of ETM+ Level 1G data. Error is referenced to a nadir-viewing geometry and excldes the effect of terrain correction.		X
3.2.3.10	The IAS shall be capable of estimating the field angles to an accracy of 0.18 arcsec, 1 sigma.		X
3.2.3.11	The IAS shall be capable of digitally correlating common featres in separate bands of the same image or same bands of separate images to an accracy of 0.1 pixel, 0.9p.		X
3.2.3.12	The IAS shall be capable of estimating the alignment of the ETM+ line-of-sight to the satellite navigation base reference to an accracy of 24 arcsec, 1 sigma, in all axes.		X
3.2.3.13	Deleted.		
3.2.3.14	The IAS shall be capable of generating the eqivalent of p to 10 ETM+ Level 1G systematically corrected scenes in a 24-hor day over the life of the mission. (NOTE: This reqirement is meant to size the maximm capacity of the system.)	X	
3.2.3.15	The IAS shall be capable of receiving and storing 10 ETM+ Level 0R scene prodcts or eqivalent per day of data from the EDC DAAC.		X
3.2.3.16	The IAS shall be capable of archiving test site image data (initial, intermediate, and final prodcts), characterization data, calibration data, calibration parameter files, and reports, generated by the IAS, over the life of the mission.	X	
3.2.3.17	The IAS shall generate monthly reports that docment the qality of 0R data and 0R prodcts retrieved from the EDC DAAC.		X
3.2.3.18	The IAS shall provide reglar calibration and performance pdates to the EDC DAAC and other interfaces qarterly.		X
3.2.3.19	The IAS shall provide an annal Landsat 7 image qality report.		X
3.2.3.20	The IAS shall have an on-line data storage capacity of 100 gigabytes (GB) (TBR) for image data.	X	
3.2.3.21	The IAS shall be capable of storing 68 megabytes (MB) of GCP data (points, chips, metadata).		X
3.2.3.22	The IAS shall capable of storing 20 GB of elevation data.		X
3.2.4.1	Deleted.		
3.2.4.2	The IAS shall spport end-to-end testing at least 12 (TBR) months before lanch.		Ops
3.2.4.3	The IAS shall be capable of spporting fll operations at lanch -6 months.		Ops
3.2.4.4	The IAS shall spport mission operations for a minimm of 5 years following in-orbit checkot (IOC).		Ops
3.2.4.5	The IAS shall operate two shifts for 7 days a week dring IOC pls 48 days (TBR).		Ops
3.2.4.6	The IAS shall be staffed dring prime shift post-IOC pls 48 days (TBR).		Ops
3.2.4.7	The IAS shall ensre backp of all on-line data and operations software.		Ops

Reqt Nmber	Reqirement Statement	R1	R2
3.2.4.8	The IAS shall perform calibrations, assessments, and evalations with freqencies specified in Tables 3.2.4-1 and 3.2.4-2.		Ops
3.2.4.8a	The IAS shall perform sensor alignment calibrations calibrations.		X
3.2.4.8b	The IAS shall perform band-to-band registrations.		X
3.2.4.8c	The IAS shall perform detector delay calibrations.		X
3.2.4.8d	The IAS shall perform radiometric calibrations.		X
3.2.4.8e	The IAS shall generate calibration reports qarterly.		X
3.2.4.8f	The IAS shall perform detector operability assessments.		X
3.2.4.8g	The IAS shall perform radiometric accracy assessments.		X
3.2.4.8h	The IAS shall perform streaking and banding assessments.		X
3.2.4.8i	The IAS shall perform correlated and coherent noise assessments.		X
3.2.4.8j	The IAS shall perform MTF assessments.		X
3.2.4.8k	The IAS shall perform SNR assessments.		X
3.2.4.8l	The IAS shall perform geodetic accracy assessments.		X
3.2.4.8m	The IAS shall perform geometric accracy assessments.		X
3.2.4.8n	The IAS shall perform Band-to-band registration accracy.		X
3.2.4.8o	The IAS shall perform Image-to-image registration accracy.		X
3.2.4.8p	The IAS shall perform Image artifact assessments.		X
3.2.4.8q	The IAS shall generate assessment reports qarterly.		X
3.2.4.8r	The IAS shall evalate LPS data qality.	X	
3.2.4.8s	The IAS shall evalate Level 0R data and prodcts.	X	
3.2.4.8t	The IAS shall evalate Level 1R data qality.	X	
3.2.4.8	The IAS shall evalate PCD qality.	X	
3.2.4.8 v	The IAS shall generate evalation reports on a monthly, qarterly, and annal basis		X
3.2.4.8w	The IAS shall perform selected trend analyses.		X
3.2.4.9	The IAS shall have the capability to maintain and pgrade all operational software.		Ops
3.2.4.10	The IAS shall be capable of spporting training withot impacting daily work loads.		Ops
3.2.4.11	The IAS shall provide an operational availability of 0.85 (TBR) or better for all processing fnctions.		X
3.2.4.12	The IAS shall spport a mean-time-to-restore (MTTR) capability of 12 (TBR) hors or better.		X
3.2.4.13	The IAS shall be capable of retrieving cross-calibration data of other sensors from the EDC DAAC.		X
3.2.4.14	The IAS capability shall be sed in performing anomaly assessment, resoltion, and reporting.		X

Appendix B — Mapping of Software Sizing Estimates to Releases

Sbsystem	Estimated DSI	R1	R2
ser Interface (I)	4100	3100	1000
Process Control Sbsystem (PCS)	1750	1750	0
Data Management Sbsystem (DMS)	8750	3750	5000
Evalation and Analysis (E&A) Sbsystem	6125	0	6125
Radiometric Processing Sbsystem (RPS)	25,850	10,950	14,900
Geometric Processing Sbsystem (GPS)	38,940	30,780	8160
Globals	3000	1750	1250
Database	7500	5000	2500
Tools	4000	2500	1500
Net Total	100,015	59,580	40,435
CCRs (20%)	20,000	12,000	8,000
Grand Total	120,015	71,580	48,435

Appendix C — Mapping of IAS Tasks and Modles to Releases

This appendix presents the mapping of IAS tasks and modles to Releases. In general, the mapping for IAS "infrastrctre" sbsystems is done at the task level. The mapping for the radiometric and geometric processing sbsystems is done at the modle or algorithm level.

Table C-1: Mapping of ser Interface Tasks to Releases

Task Name	R1	R2
Operator ser Interface (OI)	75%	25%
Analyst ser Interface (AI)	75%	25%

Table C-2: Mapping of PCS Tasks to Releases

Task Name	R1	R2
Startp IAS Software (PSI)	100%	0%
Work Order Schedler (PWS)	100%	0%
Work Order Controller (PWC)	100%	0%

Table C-3: Mapping of DMS Tasks to Releases

Task Name	R1	R2
Data Manager (DDM)	100%	0%
Ingest L0R Files(DID)	25%	75%
Ingest MOC Files (DIM)	100%	0%
Format Transmit Data (DFT)	100%	0%
Resorce Manager (DRM)	0%	100%
Ingest L0R Tape (DIT)	0%	100%
Generate Calibration Parameter File (DGC)	0%	100%

Table C-4: Mapping of "Other" Tasks to Releases

Task Name	R1	R2
Evalation and Analysis	0%	100%
Database	66%	34%
Globals	60%	40%
Tools	60%	40%

Table C-5: Mapping of RPS Modles to Releases

Modle Name	R1	R2
r0r_Main	100%	
r0r_CharCalData	100%	
r0r_CharDropLines	100%	
r0r_CharImplseNoise	100%	
r0r_CharDetectorSatration	100%	
r0r_CharScanCorrShift	100%	
r0r_CharSceneData	100%	
r0r_HistogramAnalysis	100%	
r0r_CorrCalSceneData	100%	
r0r_CombineCalSceneData	100%	
r0r_CorrectScanCorrShift		100%
r0r_CharCoherentNoise		100%
r0r_CorrectCoherentNoise		100%
r0r_CharMemoryEffect		100%
r0r_CorrectMemoryEffect		100%
r0r_SplitCalSceneData		100%
r0c_Main	100%	
r0c_CharICData	100%	

r0c_CharRandomNoise	100%	
r0c_CharDetInoperability	100%	
r0c_ProcessICReflective	20%	80%
r0c_ProcessICEmissive	20%	80%
r0c_CharSceneData	100%	
r0c_ProcessFASC	20%	80%
r0c_ProcessPASC	20%	80%
r0c_CharRelativeRadiometry	100%	
r0c_GenCorrectedGains	100%	
r0c_CorrectImageData	100%	
r1r_Main	100%	
r1r_Corrections	100%	
r1r_Banding	100%	
r1r_Striping	100%	
r1r_CharMTF	100%	
rCR_CRaM		100%

Table C-6: Mapping of GPS Modles to Releases

Modle Name	R1	R2
TMINIT	100%	
TMGRID	100%	
TMRESAMPLE	80%	20%
MODEL (LIB)	100%	
PRECISION	100%	
CORRELATE (LIB)	90%	10%
ALIGNMENT		100%
MIRROR		100%
BAND		100%
GEOMETRIC		100%
GEODETIC		100%

IMAGE-TO-IMAGE		100%
BAND-TO-BAND		100%

Appendix D— Acronyms and Abbreviations

AIT	Algorithm Implementation Team
CNMOS	Consolidated Network Management and Operations Spport
COTS	Commercial Off-the-Shelf
CSC	Compter Sciences Corporation
DAAC	Distribted Active Archive Center
DMS	Data Management Sbsystem
E&A	Evalation and Analysis
EDC	EROS Data Center
EDC DAAC	Distribted Active Archive Center at EDC
ECS	EOSDIS Core System
ENVI	Envorinment for Visalizing Imagery
ETM+	Enhanced Thematic Mapper Pls
GPS	Geometric Processing System
GSFC	Goddard Space Flight Center
GTSIM	Generic Telemetry Simlator
HDF	Hierarchical Data Format
IAS	Image Assessment System
IDL	Interactive Data Langage
LPS	Landsat Processing System
MSCD	Mirror Scan Correction Data
MO&DSD	Mission Operations and Data Systems Directorate
MOC	Mission Operations Center
MOSDD	Mission Operations and System Development Division
NASA	National Aeronatics and Space Administration
PCD	Payload Correction Data
PCS	Process Control Sbsystem
RPS	Radiometric Processing Sbsystem
UI	User Interface